

WHAT IS CLAIMED IS:

1. A manufacturing method of a semiconductor device, comprising:  
forming a trench on a surface of a semiconductor substrate;  
oxidizing thermally an internal surface of the trench;  
forming a first silicon oxide film into the trench with a high density  
plasma;  
removing the first silicon oxide film formed on a side face of the  
internal surface until a part of the side face is exposed;  
oxidizing thermally the part of the side face exposed; and  
forming a second silicon oxide film on the first silicon oxide film  
and on the side face with a high density plasma.
2. The manufacturing method of the semiconductor device of claim 1,  
wherein said removing includes isotropic wet etching.
3. A manufacturing method of a semiconductor device, comprising:  
forming a trench on a surface of a semiconductor substrate;  
forming a first silicon oxide film into the trench with a high density  
plasma;  
removing the first silicon oxide film formed on the surface until the  
surface is exposed; and  
forming a second silicon oxide film on the first silicon oxide film and  
on the exposed surface with a high density plasma.
4. The manufacturing method of the semiconductor device of claim 3,  
wherein said removing includes chemical mechanical polishing.
5. A manufacturing method of a semiconductor device, comprising:  
forming an insulating film on a semiconductor substrate,  
forming a polysilicon film on the insulating film;  
forming a trench penetrating the insulating film and the polysilicon  
film and dug in the semiconductor substrate;  
forming a thermal oxide film on an internal surface of the trench by a  
oxidation of an oxygen radical; and  
filling a first silicon oxide film into the trench with a high density

plasma.

6. The manufacturing method of the semiconductor device of claim 5, further comprising:

- 5        removing the first silicon oxide film formed on a side face of the internal surface until a part of the side face is exposed; and  
         forming a second silicon oxide film on the first silicon oxide film and on the side face with a high density plasma.

10       7. A manufacturing method of a semiconductor device, comprising:

- forming an insulating film on a semiconductor substrate;  
         forming a polysilicon film on the insulating film;  
         forming a trench penetrating the insulating film and the polysilicon film and dug in the semiconductor substrate;  
15       forming a first thermal oxide film and a second thermal oxide film by a thermal oxidation of the semiconductor substrate and the polysilicon film on an internal surface of the trench,  
         forming a first silicon oxide film on the first thermal oxide film and the second thermal oxide film with a high density plasma;  
20       removing the first silicon oxide film formed on an upper part of the second thermal oxide film; and  
         forming a second silicon oxide film on the first silicon oxide film with a high density plasma.

25       8. The manufacturing method of the semiconductor device of claim 7, wherein in said forming the first silicon oxide film, a height of a lowest surface of the first silicon oxide film in the trench is higher than a height of a surface of the insulating film.

30       9. A semiconductor device comprising:

- a semiconductor substrate having a trench on a surface;  
         a first insulating film identified by a back face contacting with a bottom face and a lower part of a side face of the trench;  
         a bottom insulator identified by a bottom face and a side face  
35       contacting with a surface of said first insulating film;  
         a second insulating film identified by a back face contacting with

an upper part of the side face of the trench and identified by an end face contacting with an end face of said first insulating film; and

5 a upper insulator identified by a side face contracting with a surface of said second insulating film and identified by a bottom face contacting an upper face of said bottom insulator.

10. A semiconductor device comprising:

a semiconductor substrate having a trench on a surface;

10 an insulating film identified by a back face contacting with the surface of said semiconductor substrate and having a first opening on the trench;

a polysilicon film disposed on a surface of said insulating film and having a second opening over the trench;

15 a silicon oxide film identified by a back face contacting with a bottom face and a side face of the trench and a side face of the second opening of said polysilicon film and identified by an uniform film thickness; and

an insulator identified by a bottom face and a side face contacting with a surface of said silicon oxide film.

20 11. The semiconductor device of claim 10, wherein an aspect ratio of the trench exceeds three.

12. A semiconductor device comprising:

a semiconductor substrate having a first trench on a surface;

25 a silicon oxide film identified by a back face contacting with a bottom face and a side face of the first trench;

a bottom insulator identified by a bottom face and a side face contacting with a surface of said silicon oxide film and identified by an upper face having a second trench; and

30 an upper insulator identified by a bottom face and a side face contacting with the second trench and identified by a height of an upper face being equal to that of an upper face of said bottom insulator.

13. A semiconductor device comprising:

35 a semiconductor substrate having a trench on a surface;

an insulating film identified by a back face contacting with the

surface of said semiconductor substrate and having a first opening on the trench;

a polysilicon film disposed on a surface of said insulating film and having a second opening over the trench;

5 a first silicon oxide film contacting with a bottom face and a side face of the trench and a side face of the first opening;

a bottom insulator having a bottom face and a side face coming into contact with a surface of the silicon oxide film;

10 a second silicon oxide film identified by a back face contacting with said polysilicon film and identified by a surface contacting with said bottom insulator and identified by one end contacting with said insulating film and identified by a height of the other end being equal to that of an upper face of said bottom insulator; and

15 an upper insulator identified by a bottom face contacting with the other end of said second silicon oxide film and the upper face of said bottom insulator and identified by a side face contacting with a side face of said polysilicon film.